MIDWEST RESEARCH INSTITUTE

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Dr. Quentin L. Hartwig, UT
NASA Consultant
Technology Utilization Division
NASA Headquarters
Washington, D. C. 20546

Subject: Monthly Progress Report No. 1, "Medical Applications of Aerospace Science and Technology," MRI Project No. 3077-E.

Dear Dr. Hartwig:

This report covers the activities of the MRI Biomedical Applications Team during May 1967.

Electrocardiogram Electrodes, Medical Problem No. KU-1: The NASA spray elctrodes were continued to be used at the University of Kansas Medical Center to obtain electrocardiograms under exercise conditions, with good results. Dr. Lauer and his co-workers prepared a paper on the work they have done with the NASA electrodes. This paper has been submitted for publication in the Journal of Physiology.

The results of the evaluation of the commercial version of the spray electrodes were submitted to the manufacturer, Hauser Research and Engineering Company, Boulder, Colorado. A modified electrode composition was received from the Hauser Company, which will be evaluated at the University of Kansas Medical Center.

Information on the spray electrode was requested by and furnished to C. Johnson, TU Officer, NASA Flight Research Center, Edwards, California; Dr. W. Hobbins, Madison General Hospital, Madison, Wisconsin; and Dr. T. Tarlo, Dalhousie University, Halifax, Nova Scotia.

Respirometer Helmet, Medical Problem No. KU-5: Representatives of the Piper Brace Sales Corporation, Kansas City, Missouri, requested information on the respirometer helmet, which was developed as a solution to Medical Problem No. KU-5. They are considering the commercialization of this helmet. Descriptive material and estimated production costs were supplied to the company representatives.

Protective Clothing for Athletes, Medical Problem No. KU-7: A special thermoplastic rubber has been developed at the Jet Propulsion Laboratory (JPL) which may be applicable to the protection of athletes. Mr. John Drane, TU Officer at JPL was contacted for additional information and samples of the material for evaluation. Mr. Drane said that he would send the requested information and determine whether samples of the material are available.

Micro Tools for Ear Surgery, Medical Problem No. KU-10: NASA Tech Brief 67-10004 describes a micromanipulation tool which may be applicable to ear surgery, as described in Medical Problem Abstract No. KU-10. A copy of the Tech Brief was forwarded to Dr. Trank for evaluation by Dr. F. Kirchner at the University of Kansas Medical Center.

Brain Lesion Device, Medical Problem No. KU-17: An experimental model of the brain lesion device, described in Quarterly Report No. 2, was assembled. This instrument is now undergoing preliminary bench tests.

Measurement of pH of Colonic Contents, Medical Problem No. KU-18: The "Heidelberg Capsule," distributed by the Meditron Corporation of America, New York, New York, is designed to measure and transmit the pH level of the gastro-intestinal (GI) tract, as required in Medical Problem No. KU-18. The unit is a small encapsulated transmitter which is swallowed and transmits pH values continuously as it passes through the GI tract. Literature on this capsule was obtained and forwarded to Dr. Trank for evaluation by Dr. J. Rhodes at the University of Kansas Medical Center.

Supports for Ruptured Eardrums, Medical Problem No. KU-23: A literature search of aerospace technology on materials which may be used as a support for ruptured eardrums was initiated through the Aerospace Research Applications Center (ARAC).

Cardiac Output Measurement, Medical Problem No. KU-24: A literature search on aerospace technology which may be applied to the external measurement of cardiac output was initiated through ARAC.

Blood Pressure Measurement, Medical Problem No. KU-25: At the University of Kansas Medical Center, there is a need for an instrument to measure and record the blood pressure of a subject while exercising. A description of this problem was prepared in Medical Problem Abstract No. KU-25.

A blood pressure measuring system, developed for the NASA Manned Spacecraft Center (MSC) by the AiResearch Manufacturing Company, described in Contractor Report CR-65057, has been identified as a potential solution to this problem. A unit was obtained from the MSC for evaluation. Arrangements have been made to evaluate this blood pressure unit at the University of Kansas Medical Center.

Intracranial Pressure Measurement, Medical Problem No. KU-26: There is a need for a method for long-term measurement of pressure inside the skull of live human subjects at the University of Kansas Medical Center. A description of this problem was prepared in Medical Problem Abstract No. KU-26, and a literature search was initiated.

Two NASA items were identified as potential solutions to this medical problem. One item is a pressure telemetry system described in NASA Tech Brief 66-10624, which was developed for the Ames Research Center (ARC). The other item is a small pressure transducer developed by the Jet Propulsion Laboratory which is described in Tech Brief 67-10020. Copies of these Tech Briefs and literature on a commercial pressure transducer were sent to Dr. John Trank for evaluation at the University of Kansas Medical Center.

George Edwards, ARC, was contacted for further information on the pressure telemetry system, Tech Brief 66-10624, and availability of a unit for evaluation. George provided additional technical data, but was unable to provide a model for evaluation. The Electro-Optics Company, who developed the pressure system for ARC, was contacted for information on availability of these units. They promised to send us the requested information.

An inquiry was sent to John Drane, JPL, requesting technical information on the pressure transducer described in Tech Brief 67-10020 and availability of a unit for evaluation.

Biological Tissue Holding Material, Medical Problem No. KU-27: There is a need for an improved material for imbedding biological preparations for microscope observations. Medical Problem Abstract No. KU-27, describing this problem, was prepared. A search of the aerospace literature related to this problem was initiated through ARAC.

Conversion of Biological Data, Medical Problem No. KU-28: Medical researchers at the University of Kansas Medical Center are

interested in a simplified method for analog to digital conversion of biological data. A literature search of aerospace technology on data conversion systems was initiated through ARAC. A conversation with C. Johnson, TU Officer at the NASA Flight Research Center (FRC), indicated that the FRC has developed some biological data conversion techniques which may be applicable to this problem. Arrangements were made for Mr. Johnson to send us further information on this work for evaluation in connection with this problem.

Measurement of Respiratory Air Flow, Medical Problem No. UM-6; Flow of Blood in Bones, Medical Problem No. UM-7; Measurement of Bone Distortion, Medical Problem No. UM-8: Reports on aerospace technology, revealed in the literature searches related to Medical Problems Nos. UM-6, -7, and -8, were ordered for evaluation.

Microcirculation Measurement, Medical Problem No. UM-10; Muscle Heat Measurement, Medical Problem No. UM-11; ECG Zero Shift Elimination, Medical Problem No. UM-12; Chest Wall Movement, Medical Problem No. UM-13; Water Extraction, Medical Problem No. UM-14: Literature searches were initiated on Medical Problems Nos. UM-10, UM-11, UM-12, UM-13, and UM-14 through ARAC. Medical Problem Abstracts were prepared on UM-10 and UM-12. Abstracts on UM-11, UM-13 and UM-14 will be prepared after the literature searches are completed.

NASA Technical Note TN-D-3497 describes work done at the Ames Research Center on the analysis of blood flow in capillaries, which is related to Problem No. UM-10. A copy of this report was sent to Dr. Kubicek, University of Minnesota, for evaluation in connection with this problem.

We wrote to Dr. M. Intaglietta, California Institute of Technology, asking him for reports on his investigations of the application of aerospace technology to microcirculation problems.

Temporomandibular Joint Action Measurement, Medical Problem No. NU-1: The further evaluation of the ARC triaxial accelerometer for the measurement of the temporomandibular joint action at Northwestern University will be delayed about a month until a pending study grant is received by the medical researchers. A literature search was initiated on this medical problem.

Electroencephalogram Telemetry, Medical Problem No. NU-3: A system for obtaining EEG's on several subjects simultaneously via telemetry is required at Northwestern University Medical School for a study of the responses of children in a group environment. Medical Problem Abstract No. NU-3 was prepared to describe this problem. A literature search was initiated through ARAC.

The Ames EEG helmet system, described in NASA Tech Brief 66-10536, appears to be applicable to this problem. We contacted George Edwards at ARC and asked him to determine whether one of the AMES helmets could be made available for evaluation. George informed us that people at the Douglas Aircraft Company are doing some work with similar helmets. Inquiries were sent to the Douglas Aircraft Company for further information on their work.

Phonocardiograph Microphone, Medical Problem No. NU-4: Medical researchers at Northwestern University are extensively involved in the development and application of heart-sound computer systems. They are currently involved in evaluating phonocardiograph microphones for one of their heart-sound systems.

NASA Tech Brief 66-10314 describes a phonocardiograph microphone which may be applicable to the Northwestern heart-sound system. A copy of the Tech Brief and Document No. MSC-212, which provides details of this microphone, were forwarded to Mathew Petrovick at Northwestern University. We contacted Mr. Chmylax, at the MSC TU Office and made arrangements for one of these microphones to be sent for evaluation at Northwestern.

Muscle Accelerometer, Medical Problem No. SLU-7: The application of the muscle accelerometer to measure muscle action was continued at St. Louis University Medical School, with good results. Two accelerometers were sent to Sister Claire to replace two damaged units.

Two graduate students at Southern Illinois University are planning to conduct muscle tremor studies with this accelerometer. They visited Sister Claire for a demonstration of her techniques for applying this accelerometer.

Information on the muscle accelerometer was furnished to Dr. A. G. Dinaburg, Oakland, California, and the Piper Brace Sales Corporation, Kansas City, Missouri. The latter is considering the commercialization of the accelerometer.

Measurement of Blood Oxygen, Medical Problem No. SLU-8: A report entitled, "Wearable, Wireless Oximeter," NASA Accession No. N65-30480, describes an instrument for measuring blood oxygen, developed by the Beckman Company for ARC. This instrument appears to be applicable to Medical Problem No. SLU-8. A copy of this report was sent to Dr. Richardson for further evaluation.

Miniature Motors and Batteries, Medical Problem No. CI-1: Summaries of government-supported research projects related to Problem No. CI-1, furnished by Smithsonian Institute Science Information Exchange, were forwarded to Dr. Reswick, Case Institute of Technology.

A copy of the aerospace literature search previously conducted on this problem was requested by and furnished to M. Petrovick, Northwestern University.

Joint Locks for Orthosis, Medical Problem No. CI-2: Four NASA items were identified as potentially applicable to Medical Problem No. CI-2. These NASA items include a braking mechanism, described in NASA Tech Brief 66-10484; a solid-state circuit control, described in NASA Tech Brief 66-10486; a hydraulically controlled flexible arm, described in NASA Tech Brief 66-10626; and an adjustable hinge described in NASA Tech Brief 67-10056. Copies of these Tech Briefs were sent to Dr. Reswick, Case Institute of Technology, for evaluation. Summaries of government projects related to this problem, furnished by the Smithsonian Institute Science Information Exchange, were also forwarded to Dr. Reswick.

The aerospace literature search on this problem was requested by and furnished to M. Petrovick, Northwestern University.

Centrifuge Effects on the Cardiovascular System, Medical Problem No. CI-6; Modeling of the Heart Control System, Medical Problem No. CI-7; Effects of Posture on the Cardiovascular System, Medical Problem No. CI-8: Literature searches were completed on Medical Problems Nos. CI-6, CI-7 and CI-8. A considerable number of aerospace reports were revealed in each of these literature searches. The results of these literature searches and six reprints of pertinent papers were sent to Case Institute of Technology for evaluation.

Eyelid Closure Recording, Medical Problem No. UW-2: A North American Aviation report, "Feasibility of Techniques for Monitoring Physiological Variables Without Attached Sensors," Final Report, NASA

Contract No. NAS12-1, 4 November 1966, describes eyeblink measurement techniques which may be applicable to Medical Problem No. UW-2. A copy of this report was sent to Dr. H. Ludwig, University of Wisconsin Medical Center, for evaluation.

Summaries of government-supported projects related to this problem, furnished by the Smithsonian Institute Science Information Exchange, were also forwarded to Dr. Ludwig.

Miniature Equipment for Auditory Stimuli, Medical Problem No. UW-3: A student at the Kansas City Art Institute has developed a headphone which may solve Medical Problem No. UW-3. A copy of his report, "Equipment for Presentation and Response Determination of Auditory Stimuli," by J. Holzaepfel, was forwarded to Dr. Ludwig, University of Wisconsin, for evaluation. Mr. Holzaepfel worked on this problem as a result of discussion with members of the MRI Biomedical Applications Team.

Miscellaneous Activities

1. Evaluation reports on 17 NASA Center suggestions were prepared.

2. Dr. Kubicek requested a number of reference reports. These reports were ordered.

3. SDI report listings were sent to Drs. Kubicek, Richardson and Trank.

4. A paper on the muscle accelerometer and the spray electrodes, prepared by D. Bendersky, has been accepted for presentation at the 7th International Conference on Medical and Biological Engineering, Stockholm, Sweden, on 18 August 1967.

5. A subject interest listing was submitted to the ASTRA Project. All pertinent aerospace reports will be screened by ASTRA personnel and forwarded to the Biomedical Applications Team for evaluation.

6. Up-to-date information on the walking wheelchair was requested from Space General Corporation, El Monte, California, and the Rancho Los Amigos Rehabilitation Center, Downey, California. This item is of interest at the Northwestern University Rehabilitation Institute.

7. Dr. W. Ko, Case Institute of Technology, requested copies of progress reports on the MRI Biomedical Applications Team program. Copies of prior progress reports were sent to Dr. Ko and his name has been placed on the report distribution list.

8. General information on the Biomedical Applications program was requssted by and sent to Dr. Warren McGonnagle, Elmhurst, Illinois.

9. Information on MEDLARS literature search services was requested from the National Library of Medicine.

10. Preliminary arrangements were made to visit the University of Wisconsin Medical Center in June to encourage greater participation in the BAT program.

This report was prepared by David Bendersky, Director, MRI Biomedical Applications Team. Dr. Trank's report is attached.

Sincerely yours,

MIDWEST RESEARCH INSTITUTE

Paul C. Constant, Jr., Manager
Technology Utilization

Approved:

Harold L. Stout, Director
Engineering Division

Attachment